Low-Energy Cooling Systems

Space Cooling in California

Space cooling in CA commercial buildings accounts for ~5% (14,000 MWh) of California's total annual electrical energy consumption and ~14% (7.1 GW) of its total peak demand (Figure 1).

There is significant potential to reduce consumption, since conventional HVAC systems typically do not take full advantage of CA climatic conditions.

There are four aspects to Low Energy Cooling (LEC):

- Eliminate or reduce chiller use by dissipating heat directly to the environment.
- Cool spaces more effectively by taking advantage of space temperature stratification, allowing higher supply air temperatures.
- Shift and/or smooth peak demand with thermal mass by storing off-hours precooling in the building structure.
- Improve distribution system efficiency — reduce leakage and thermal losses from duct systems or use water instead of air to reduce parasitic losses.

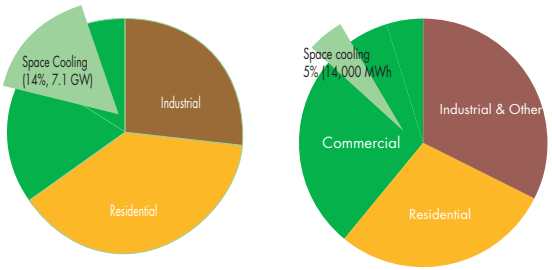
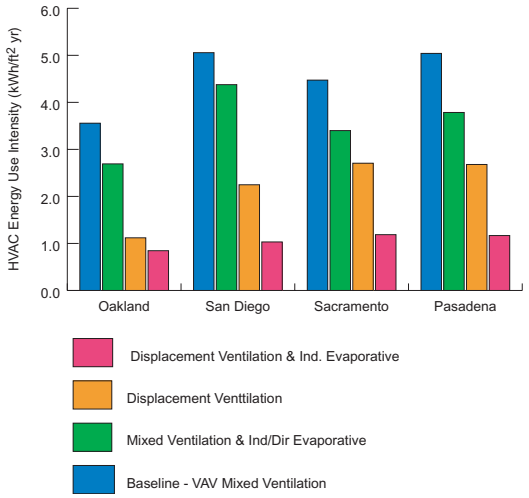


Figure 1. Power consumption (l.) and Energy use (r).

Low-Energy Cooling Systems— A computer simulation appraisal using DOE2.1E and EnergyPlus

Results from a recent parametric computer simulation of potential energy and demand reductions shows that some low-energy cooling (LEC) methods can provide up to 40% savings in non-residential buildings in California climates.

Total HVAC energy use intensity (kWhft^2 yr)



LEC Uses Climatic Opportunities

Promising LEC Systems from the Study

- Displacement Ventilation - maintains comfort with a higher supply air temperature but same air flow rate as conventional systems.
- Cooled Beams - the occupied space is cooled by circulating cool water through exposed fin-tubes in the ceiling.
- Indirect/Direct Evaporative Pre-Cooling - indirect evaporative cooling cools without increasing the humidity in the occupied space.

Benefits emerging from this study:

- Indirect evaporative pre-cooling is beneficial in all populous CA climates, even the coast regions.
- Indirect evaporative pre-cooling savings can be increased with displacement ventilation systems.
- Cool beam systems can reduce peak load significantly by reducing fan power.
- Peak demand is reduced by increased distribution efficiency or thermal storage capacity.

Interested?

Building owners, operators, and designers can use LEC technologies to reduce operating costs while improving occupant health and comfort.

Key next steps include additional simulation appraisal, development of design tools, and public workshops:

- Using EnergyPlus™ to provide greater accuracy and model systems than cannot be modeled with DOE-2:
  - Radiant cooling (exposed slabs and ceiling panels)
  - Natural ventilation
  - Displacement ventilation (detailed models)
  - Stand-alone, compressorless systems

- Develop design reference tables and EnergyPlus™ system templates.
- Conduct public workshops for design professionals and building managers.

Additional information can be found on this website:
http://buildings.lbl.gov/hpcbs/Element_4/02_E4.html

This project is part of LBNL's High-Performance Commercial Building Systems program, a three-year public-private research initiative targeting substantial reductions in the energy costs of commercial buildings.

For access to all program results, see:
http://buildings.lbl.gov/hpcbs

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Low Energy Cooling Systems

Low-Energy Cooling Systems for Commercial Buildings

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